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Book 12
Slope and Terrain Data

Seafarer Site Survey
Upper Michigan Region

BOOK 12

SLOPE AND TERRAIN DATA of the UPPER MICHIGAN REGION PROJECT SEAFARER

for
U. S. Navy. Naval Electronic Systems Command

by
EDAW, Inc., 50 Green Street, San Francisco 94111

Under Contract to
GTE Sylvania, Communication Systems Division

April, 1976

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The Study Area and the land farther to the west is quite rocky and either mountainous or rolling. The Huron Mountains are located within the area and have a lake/knob topography with high rocky tree covered crests and many lakes between them. In these mountains, the steepest terrain in the area occurs with a vast majority of the range having slopes over 20% and some areas with slopes in excess of 45%.

The land along the eastern portion of the Study Area boundary is flat with only small isolated areas having slopes steeper than 10%.

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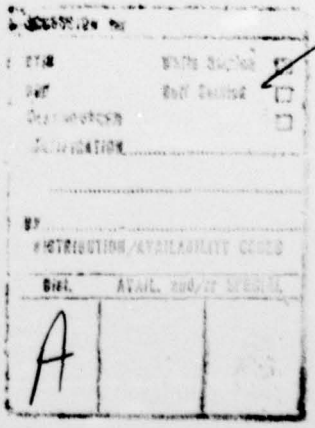

SUMMARY

Unlike the plains states and even the majority of the surrounding Great Lakes region, the Upper Peninsula contains dramatic shifts in topography. The land forms of the Upper Peninsula visually describe its geologic history. The most ancient rocks of North America, part of the Laurentian Shield, appear at the surface toward the west end of the area but the eastern portion is buried under old sea beds of sand. The broad range of landforms provides variety, creates intimate corridors, elsewhere allows long scenic vistas, and offers significant recreational opportunities.

The topological character, geologic history, soils and topographic orientation divide the Upper Peninsula into two major parts. The significant division is along the east edge of Marquette County and the western boundary of Menominee County. This is also approximately the eastern boundary of the Study Area.

The Study Area and the land farther to the west is quite rocky and either mountainous or rolling. Great Lakes frontage occurs on Lake Superior from L'Anse in Baraga County to Marquette and into Alger County. This contrasts with the eastern half of the Upper Peninsula which is typified by level to rolling topography.

One of the three mountain masses in the Upper Peninsula, the Huron Mountains, is within the Study Area. This mass is located in the northeastern section of Marquette County. Two other mountain areas, the Porcupine Mountains and Brockway Mountains are located to the northwest of the Study Area. The Huron Mountains have a lake/knob topography with high, rocky, tree covered crests and many lakes between them. It is in the Huron Mountains that the steepest terrain in the Study Area occurs. The vast majority of the range has slopes over 20%, with large areas over 45% slope.

Much of Baraga County has areas of slope in the 20-45% range. Another dominant characteristic of this County is the hummocky terrain which is characteristic of glacial moraines. These systems of hills are traceable for miles across the landscape with slope ranges in the 10 to 20% category.

The relatively flat land characteristic of the central portion of the Study Area in Iron, Dickinson and parts of Marquette Counties can be associated with glacial till,

ground moraines and glacial outwash. Glacial till consists of glacial drift accumulated from heterogeneous soil materials and rock fragments lodged beneath glacial ice and from materials dropped onto the land surface upon melting of glacial ice. Ground moraines consist of till having low relief and no transverse linear elements. Glacial outwash is coarse grained, well sorted deposits that were washed out beyond the glacier front by melted ice water. Only around the Towns of Iron Mountain and Norway is there any topographical relief with slopes greater than 20%.

The land along the eastern portion of the Study Area boundary is flat with only small isolated areas having slopes steeper than 10%. The lands are mostly glacial till and alluvium deposits with some glacial outwash. The Menominee County area in the southeast of the Study Area forms a special territory of its own. It is made up of drumlins which are smooth, oval cigar-shaped hills whose axes show the direction of glacial flow, old sea beds and some rolling terrain associated with end moraines, long relatively continuous hills that are tens to hundreds of feet high. This is the only section within the Study Area in which drumlins are found.

The Slope and Terrain Data map that accompanies this narrative was prepared by interpreting quadrant maps published by the U. S. Geological Survey. A strong relationship exists between this map and the Surficial Geologic and Soils Data Map.

EVOLUTION

Processes Leading to Existing Conditions

In Upper Michigan, although there were several glacial stages during Pleistocene time, the deposits left by the earlier ice sheets have been totally obliterated. All glacial deposits present in the Study Area are products of the last glaciation, the Wisconsin Ice Age. During this episode of glacial advance, ice fanned out from the Laurentian Highlands (east of Hudson Bay) and advanced southward as far as Ohio, Indiana, and central Illinois. Besides removing earlier glacial deposits, the Wisconsin ice sheets removed more of the pre-existing bedrock, and left behind the surficial deposits which now exist throughout most of the area.

The glaciers left behind an irregular suface with isolated rock knobs, gently rolling smooth surfaces, and fairly deep canyons covered by a mantle of unconsolidated debris which varies in thickness from a few feet in some places to several hundred feet in others, with isolated areas of protruding bedrock. The melting of the glacial ice resulted in various depositional environments, including meltwater streams, lakes, ice tunnels, and the receding ice sheet itself. These distinctive modes of deposition resulted in certain types of landforms and glacial deposits such as drumlins, moraines, ground moraines, lake plains, and glacial outwash.

Since the retreat of the Wisconsin glaciers approximately 10 to 11 thousand years ago the glacial terrain has been modified only slightly. During this relatively short interval of geologic time, climatic conditions have become more moderate, drainage patterns have developed, erosion has taken place, and soil horizons have begun to develop on the glacial deposits. Because of the short time span involved in terms of geologic processes, landforms and drainage patterns are generally in an immature state of development. Consequently the topography of the area shows characteristics of form or drainage related to the underlying rock strata or of the landforms left behind after the glacial retreat.

Anticipated Future Conditions

The Upper Peninsula of Michigan is presently geologically stable, with no significant tetonic, volcanic, or seismic activity. A steady state condition in the soils prevails

within the areas where man has not modified the land surface. Under present climatic conditions, erosion while being relatively slow, will continue, and landforms, surface drainage patterns, and soil horizons will develop to a more mature state. Man's activities appear to be the only factor that can significantly alter the present landscape within the immediate future. Activities such as increased farming, mining and urban development could locally increase the rates of erosion.

DISTINCTIVE UNITS AND CHARACTERISTICS

Detailed descriptions of the units shown on the Slope and Terrain Data Map are as follows.

Category 1

The slope range is 0-10%. The majority of the Study Area falls into this category where the landscape is relatively flat with occasional mounds and depressions. A significant percentage of the area is either permanent or seasonal wetlands found in depressions at varying elevations. Lack of cultivation and extensive forest cover are also a result of poor drainage. This condition is most prevalent in the center of the Study Area including parts of Iron, Dickinson, and Marquette Counties. Around the Keweenaw Bay area low lying wetlands can also be found.

Category 2

The next largest category within the Study Area has a slope range of 11 to 20%. The topography within this range is gently rolling. There are also areas of hummocky terrain containing many small scale depressions and knolls. The major landforms that make up this designation are drumlins and moraines.

A drumlin is a low, smoothly rounded elongated, oval hill or mound of compact glacial till, ranging from 10 to 100 feet in height and less than one half mile in length. Because of their height, drumlins offer greater viewing capacity than their typically flat surrounding landscapes. Drumlin hills are relatively low, however, and therefore do not provide any major regional views. Drumlin hilltops and ridges are visually dominant when viewed from surrounding lowlands. They are significant landforms within this region. The drumlins are concentrated in the southeastern corner of the Study Area in Menominee and part of Marquette County.

Another prominent glacial feature is the unique system of hills, called moraines which are traceable for miles across the landscape. Moraines as landforms typically form a linear, sometimes crescent shaped band of discontinuous hills and depressions whose elevation differences seldom exceed 500 feet. The most sensitive visual zones are the tops of the highest hills or the slopes and tops of the hills on the edge of the moraine deposit adjacent to other lowland landforms. Since these landforms add diversity to the flat monotonous surrounding landscape, they are valuable

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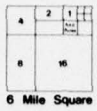
Upper Michigan Region



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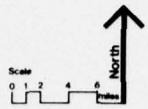

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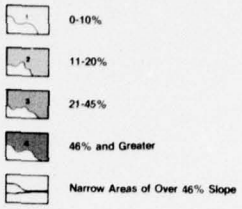

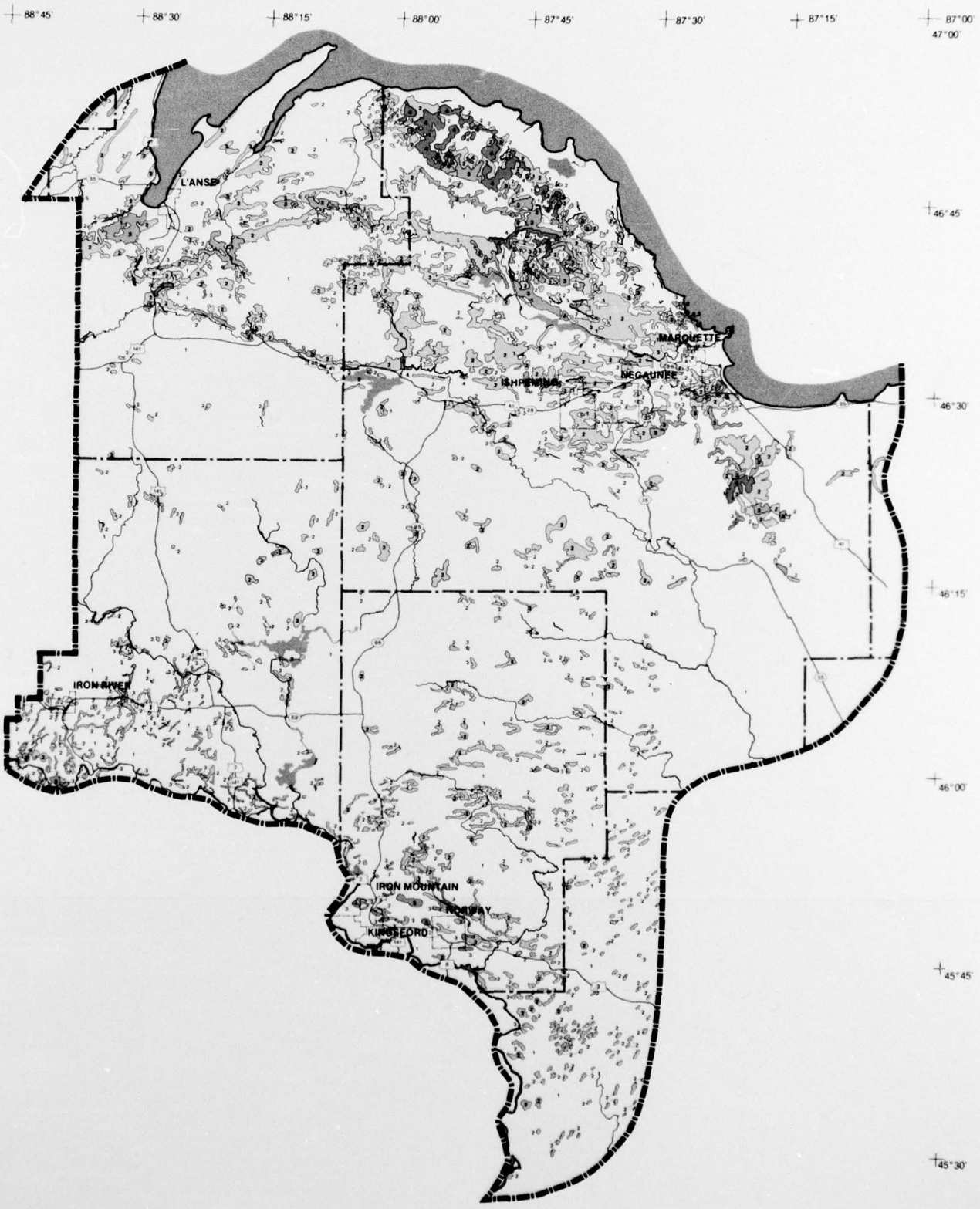

for recreation sites. The moraines occur throughout the Study Area but are more visually evident in its central portion.

Categories 3 and 4

The remaining categories include slope ranges of 20 to 45% and greater than 45%. The terrain in these categories is very significant to the region since topographical relief is rather uncommon.

Typically, the terrain becomes more rugged as the steepness of the slope increases. The location of slopes in these categories strongly relates to the bedrock classifications of the Surface Geologic Data Map in that the steeper areas generally coincide with the more resistant rock formations. The land surface shows characteristics of form or drainage derived from the underlying rock strata. In the Study Area the topographic form generally reflects the massive character of the crystalline bedrock. The greatest percentages of forest cover coincide with the most rugged topography. The bedrock is generally at a depth of at least 6 feet in a majority of the area in these categories. Rock outcropping is generally found in the steepest terrain category with slopes greater than 45%.

The two steepest slope categories are found mostly in three locations of the Study Area. The largest of the three areas, and the most rugged is the Huron Mountain Range which occurs in the north of the Study Area along the Lake Superior shoreline and extends southeast as far as Marquette and Negaunee. These mountains have a lake/knob topography with high rocky and tree covered crests. Almost all of the slopes over 45% in the Study Area occur here. This area has the most significant landforms in the entire study region as well as in the rest of the Upper Peninsula. The heavy regular snowfall, varying topography with prominent land features offering major views and the many lakes make this area excellent for year round recreational activity. Small less rugged areas of these slope categories occur around the towns of Sidnaw and Herman in Baraga County around the western edge of the Study Area. In the southern portion of the Study Area around Iron Mountain and Norway in Dickinson County small sections of rugged terrain occur mostly with slopes in the 20 to 45% range.

RELATIONSHIP TO OTHER DATA

The terrain features of the Study Area are related to soils, surficial geology, surface water and vegetation. For example, the thickness and degree of development of the soil horizons are determined partially by the volume of water that can percolate through the weathered parent material, which is a function of both the permeability of the parent material and topographic position. With the same parent material, soils on slopes tend to have better internal drainage than in the lowlands because of the lower ground water table.

Surficial geology in the Study Area is, to a degree, related to topography. For example, topographically steep or rugged areas, knobs, ridges, etc., are generally underlain by hard rock such as granite, with little or no surficial cover. Rolling or gently undulating terrain is mainly underlain by moraine or till. Low plains generally are underlain by glacial lake deposits of significant thickness except for isolated rock knobs or areas where stream channels have eroded down to bedrock.

The amount of forest vegetation and cultivated land is directly related to the topographic relief and the thickness of soil cover. In the northern portion of the Study Area the terrain is more rugged with thinner soils and greater percentages of forest cover. Lands in the southern part of the Study Area are flatter with thicker soils and consequently more cultivated lands. Swamps, bogs, and marshes can be found in the lowland terrain with its glacial depressions, while the mixed hardwoods and conifers are located on the upland terrain.

VALIDITY

The slope magnitude classes were selected for their dollar cost relationship to the probable construction methods associated with the project, i.e., plowing, trenching, ripping and blasting. The Data Map was made by interpreting contours from published 15 and 7½ minute U.S.G.S. quadrangles dated from 1944 to 1956. The contour interval for these Maps was generally 20'. It should be emphasized that because of the scale of the base map and the size of the Study Area, the slope categories delineated are somewhat generalized. Within many of the categories there may be some local areas that may have lesser or greater slopes than are shown. Generally areas smaller than 40 acres or narrower than 400 feet are not shown.

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